# Driving Innovation: Ready, Set, Go!

**In our increasingly networked world, prizes are gaining a foothold in the race for innovation in science and technology. Amy Maxmen reports.**

Competitions are coming back. According to a 2009 McKinsey Report, prizes awarded as incentives for innovation have been increasing over the last decade in science, engineering, environmental research, and space exploration (http://www.mckinsey.com/App_Media/Reports/SSO/And_the_winner_is.pdf). President Obama recently directed federal agencies to increase their use of incentive prizes as a tool for stimulating technological innovation. And in December, program directors at the National Institutes of Health (NIH) gathered in a closed meeting to discuss incentive prizes with the chief of DARPA, the Pentagon's research agency. Among federal agencies that fund research and development, DARPA has taken the lead in implementing prizes, starting with its 2004 contest to create an unmanned ground vehicle. Although neither the NIH nor the National Science Foundation yet has legal authority to establish prizes for targeted innovations, they've solicited extensive advice from the National Academies regarding such prizes. The NIH has also consulted with leaders at the X Prize Foundation (http://www.xprize.org/), a company that creates and manages prizes awarded to the first team to achieve a specific goal, and InnoCentive (http://www.innocentive.com/), a company that posts challenges online for organizations seeking solutions, so that people around the world can compete to solve them for a bounty. "When you consider that the government invests a total of $150 billion in research and development, there's a lot more room for experiment in this area," said Thomas Kalil, the Deputy Director for Policy at the Office of Science and Technology Policy, at the X-Prize-sponsored "incentive2innovate" conference held at the United Nations in New York (http://i2i.xprize.org/). The Bill & Melinda Gates Foundation has climbed on board too, recently announcing that they would sponsor an X Prize to develop a practical and more accurate test for tuberculosis.

Incentive prizes also are finding a new niche in translational research. At the Harvard Catalyst (http://catalyst.harvard.edu/), an enterprise for clinical and translational medicine founded in 2008, researchers are looking into how incentive prizes could be used to stimulate innovation in healthcare-related areas with a series of exploratory contests. "We hope these pilot programs will create solutions, but we are also using them to learn about how cooperation operates," says Karim Lakhani at Harvard Business School, who is applying his research on InnoCentive's strategy to help design Harvard's competitions.

Later this month, Harvard will launch a search for new solutions for type 1 diabetes by posting a challenge on their internal websites as well as on the InnoCentive website. Cash prizes will be awarded for winning hypotheses or concepts. And if all goes according to plan, Harvard investigators will then take these solutions to the next level by conducting experiments to see if they work. In another new pilot competition, professors from Harvard Medical School, MIT, Harvard Business School, and the London Business School have teamed up with TopCoder (a company that administers online contests for organizations who need software developed) to solicit solutions for computational problems in genome datasets.

Prizes make sense from a marketing perspective. The financer explains what they seek and places the risk squarely on the competitors, who offer up their time, money, and brainpower with no guarantee of success. Compare this to the grant strategy, in which there's a fair chance that the person receiving funding will not accomplish their stated goal. Peter Diamandis, CEO of the X Prize Foundation, describes the benefits of the first X Prize of $10 million for launching an affordable, privately funded spacecraft into space this way: "We leveraged the prize purse by ten-fold, it was perfectly efficient because we paid on delivery of the results, and we brought a new mix of investigators into the marketplace that did not exist before."

Why people choose to compete is another question. One answer: It's in our nature. InnoCentive's CEO Dwayne Spradlin says, "The number one reason why people participate [in competitions] is because they want to work on problems that matter. If there's a $10,000 prize, that solution is of value to someone." It's little wonder that the biggest fans of prizes flock to the highly publicized TED Talks (http://www.ted.com/), a non-traditional conference devoted broadly to "ideas worth spreading." Attendees include scientists, philosophers, celebrities, entrepreneurs, and major investors (who have bankrolled prizes after hearing certain talks). Although incentive prizes aren't awarded at the talks, founders of the X Prize and another incentive prize, the M or Methuselah Prize (with the lofty goal of extending human life), have spoken at the event. "If you get the public to cheer on scientists like they do runners during a marathon, you'll get things moving," says Marc Hodosh, Senior Advisor for the Archon X Prize for Genomics—a competition to decode 100 human genomes in 10 days for less than $10,000 a genome—and president of a new type of TED Talk devoted to health and medicine, TEDMED (http://www.tedmed.com/).

Yet the prize movement is countered by skepticism. Can breakthroughs be predicted? And who can afford to finance their work up-front? Kathy Hudson, the Chief of Staff to NIH Director Francis Collins, says that she and others at the NIH are sifting though potential complications to explore if prizes could work for them. "One of the challenging aspects for us, because we are such a large supporter of biomedical research, is that if we were to have a prize mechanism, the people competing would also be our grantees. And there is something odd about that," she says. "This is a serious thing to think about. What if we had two

grantees competing for a prize and one grantee had more funding from us." She adds, "I understand the Gates Foundation is considering prizes, and they are in an analogous position." The NIH is also grappling with what makes an appropriate prize target and what metric could be used to evaluate the solution. Nonetheless, Hudson says the prize concept is intriguing, "Francis [Collins] has been giving it thought and the Office of the Director has been giving it thought."

Likewise, Eva Guinan, a transplant physician at Harvard Medical School who is guiding the contest for solutions for type 1 diabetes, says, "It was clear from the beginning that this would be challenging. Right now, we're just setting off on an academic journey to explore what parts of this approach are useful in our communities and what parts aren't. We've joined up with several companies, including TopCoder and InnoCentive, and Harvard Catalyst was fortunate enough to be awarded supplementary ARRA [American Recovery and Reinvestment Act] funding to study how this sort of initiative is best implemented, starting with a focus on novel approaches to type 1 diabetes."

## Solutions Wanted

Two scientists at the pharmaceutical company Eli Lilly dreamed up InnoCentive in 2001 as a way to use the web to outsource problems that weren't being solved in-house. InnoCentive branched off from Eli Lilly in 2005 and expanded its services to a variety of industries. Solutions sought range from creating algorithms and software to identify gene networks from microarray data to new strategies for treating autoimmune disease. The firm operates by helping organizations, called "seekers," to post challenges on the firm's website for a fee. Registered "solvers" then compete to win cash prizes offered by the "seekers." If the problem is solved, InnoCentive earns a finder's fee. The company now also offers consulting services and software that enables businesses to post challenges within their organization.

Advertising competitions allows organizations to turn to anyone with internet access for answers. "Crowdsourcing," the term for this phenomenon, may be new, but the concept is centuries old. In 1714, the British Parliament held a contest to find a way to accurately determine a ship's longitude. A clockmaker took home the largest award for inventing the marine chronometer. A similarly anonymous 25-year-old airmail pilot, Charles Lindbergh, won the $25,000 Orteig Prize in 1927 for flying nonstop between New York City and Paris, beating famed pilots.

"There are more than enough people who are bright and passionate, and you want to tap these people at the right time so they can work on these important problems," says Spradlin. About 60% of the 190,000 registered solvers currently competing for InnoCentive prizes have a Masters degree or a PhD. More than 40% of registered solvers come from Brazil, Russia, India, and China; 30% from the US; and the remainder from over 150 other countries. Regarding Harvard's type 1 diabetes challenge, Guinan says, "You might imagine that someone who works with disenfranchised children could have a good idea about how to motivate youths to do mundane tasks like take insulin. Maybe someone who works in museum design, who knows how to facilitate the way people walk through an exhibit, might be able to design something that will help individuals whose activities are impeded by diabetic neuropathy." She says, "We are seeking new ways to bring scientists to different tables; new ways to expose the ideas of scientists who are at unempowered spots in the academic hierarchy; and we are trying to figure out how to get ideas from people who don't have the resources to enact their ideas."

Experts stand to gain from crowdsourcing as well. Harvard neurologist Seward Rutkove competed in an InnoCentive challenge seeking a way to track the progression of amyotrophic lateral sclerosis (ALS), or Lou Gehrig's disease, because he was researching that topic already. He won $50,000 for presenting his solution and was prepared to stop there, rather than reach for the $1 million prize to demonstrate the ability of treatment to ward off an ALS-like disease in mice. Yet he learned something that changed his mind—access to the relevant strain of mice. "If they'll provide me with free animals, I'll enter because even if I don't win the prize I might get a paper out of it," he says. "I do have this vague idea I've been cooking for a couple of years and now I have a chance to see if it comes true or not." Access to genome sequence data for 250 lines of corn may entice geneticists to enter InnoCentive's upcoming Corn Genomics Challenge for a computationally derived indicator of the plant's performance in fields with imperfect growing conditions. And top competitors in the upcoming Healthcare X Prize—which seeks a strategy to improve healthcare value by >50% in a 10,000-person community over 3 years—will be able to try out their solutions on real populations.

## The Thrill of the Chase

Bigger prizes require larger investments from both seekers and solvers. Thus, the stakes are high at the X Prize Foundation, where prizes range from $1 to $30 million, and challenges take years to formulate. Harvard geneticist George Church helped to sculpt the rules and ethics guidelines for the $10 million Archon X Prize for Genomics. Having been involved with the Human Genome Project, he was familiar with complications, such as privacy issues, inherent to the field. Biological chemist Steven Benner is stumbling over other matters as he and his team pursue the prize. "We spent the first year asking about the criteria we needed to meet for their challenge. Now we have technical questions, like will the samples be from sperm, blood, or tissue?" And, the Foundation has yet to define how they will validate contestants' data. Church, who has stepped down from the X Prize committee to compete, says stoically, "This prize has a way of warping the field." Benner questions if the field is being warped in the right direction. He says, "The winner of the Archon Prize will need to solve the problem in genome sequencing that appears to have the least value—sequencing the repeating, noncoding regions." He says genome-related questions that help to tackle disease might do more public good, as would a solution to the problem of how to interpret sequences. "The pink elephant of genomics is that we know little more about Craig Venter now that we have his DNA, than we knew before."

Smaller prizes posted by InnoCentive may be fraught with fewer complications. A $20,000 challenge seeks a method to optimize tags for protein expression in plants; a $150,000 challenge seeks a stable protein that mimics a trimeric HIV envelope protein; and a $30,000 challenge calls for a method to characterize functional groups on the outer surface of keratin fibers like hair and wool. A solver presenting a theoretical solution to this problem stands to win $15,000. This partial prize might please skeptics like biochemist Kary Mullis, winner of the 1993 Chemistry Nobel Prize for inventing PCR, who fears that not all innovators have money jingling in their pockets. Mullis says, "Prizes are nice but they don't help us recognize an unaccomplished person in the very beginning." Instead, he says, "If I were in a situation with an extra billion hanging around and I wanted to promote innovation, I would consider giving a prize, not for developing something, but for writing something that describes a potential development...That early phase between the creation of an idea and the defining experiment is the most treacherous part of an adventure."

Harvard economist Michael Kremer explores alternatives to incentive prizes—other means of providing the "pull" that is lacking in scientific fields not backed by a market. For example, biotech and pharmaceutical companies avoid developing drugs for treating neglected diseases because of the risk that they may not recoup their costs when low-income individuals cannot afford the treatments they offer. Kremer says, "In the US, the NIH provides the 'push' by putting money up front for science. And in some cases, such as in cancer research, pharmaceutical companies provide the 'pull.' What's missing out there for neglected diseases and basic science is the 'pull' component." Kremer and his colleagues have convinced the Gates Foundation and four countries to put forth $1.5 billion for an alternative incentive, an Advanced Market Commitment (AMC) for neglected diseases that will reward the winning team with a purchase order for a certain number of pneumococcal vaccines at a set price. Kremer adds that fundamental research may not benefit from AMCs because the results may not be marketable.

## Fame and Fortune

Teams often manage to raise money as they compete and gain popularity. Indeed, the X Prize Foundation has succeeded in making science glamorous. Multiple television companies have approached the X Prize Foundation in the hopes of documenting the $10 million Automotive X Prize for an economically viable and energy-efficient car. And Google cofounder Larry Page, CNN's Larry King, and theoretical physicist Stephen Hawking have joined the "Genome 100," a group that will have their genomes sequenced, and will in the meantime be spokesmen for the Archon X Prize in Genomics. "Ultimately, our job is to be good to the teams. We make them heroes globally, so that they can raise money from benefactors and investors. We pick a breakthrough that is audacious, practical, and of value to humanity," says X Prize Foundation CEO Diamandis. "We want the world to recognize that these are heroes who strive to achieve something of value. During the course of the Archon X prize, the public will really start to grasp the concept of personalized genome sequencing, and they will want to participate."

"This is about a celebration of science and the people who solve problems. Today our society celebrates entertainers and athletes. There's nothing wrong with that, but it is a little out of whack. We should be celebrating scientists, engineers, and innovators. It's about changing our culture," says TEDMED President and X Prize Senior Advisor Marc Hodosh. "Organizations are realizing they need to innovate and that they need to think differently about that process. We like to say, a crisis is a terrible thing to waste. We think organizations can come out stronger from this economic crisis by doing two kinds of research, by tapping their internal and external talent pools," says InnoCentive CEO Spradlin. "This past year, we've found ourselves in a weird position of leadership where organizations are looking to us and changing the way they think about innovation."

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